Setting Utility Access Covers

Background of the Invention

1). Field of Invention

This invention relates to setting utility access covers to grade and more particularly to apparatus for rubblizing the material around the utility access and a method for setting utility access covers to grade including rubblizing material, removing the rubblized material and establishing the proper position of a utility access cover when renovating, reconstructing or installing new access covers.

There are a number of utilities that are underground and that have components that have to be accessed. Some of these components are meters, valves and pipes, for example. Some require servicing or inspection underground by personnel. In this case, there must be a manhole with a sufficiently wide opening for a person. In other situations, underground access by personnel is not required. In both cases, it is often necessary to set the access cover to grade.

2). Related Art

The apparatus and method will first be described in connection with manholes, and then with respect to other utility access covers, including small ones used for such things as water valves. Manholes are associated with access to underground utilities. There are many different sizes and construction of manholes, but all have a cover that should be set according to the grade of the surrounding material. Some have standard components and sizes, such as sanitary sewer manholes in some parts of the United States. These manholes have a 24-inch (2-foot) diameter lid or cover and a ring that holds and supports the cover. The ring has an outside diameter of 25 ½ inches and a cylindrical outer body with a height between 4 inches and 8 inches. There are also inverted rings with 1-inch height. The ring, other than inverted rings, has a circular flange around the body near the bottom to support weight and to hold it in place. Not all rings have flanges. Nevertheless, for purposes of illustration, rings with flanges will be described. The ring sits on the top surface of an eccentric cone that has an internal diameter of 2 feet at the top and 4 feet at the bottom. The cone sits on a manhole barrel section. The barrel section has an inside diameter of 4 feet and a wall thickness of 5 inches. Above the barrel section the eccentric cone transitions from the 4-foot internal diameter of the barrel section to the 2-foot internal diameter at the top of the cone. The wall

thickness of the cone varies from 6 inches at the top to 5 inches at the bottom where it mates with the barrel section. The barrel section rests on a foundation that supports the components of the manhole and the utility to be accessed. Often times, one or more height adjusting rings or material is positioned between the bottom of the ring and the top surface of the cone to adjust the cover to grade so that it is even with and aligned with the surface of the roadway. Also, on occasion, when a roadway has a new layer of asphalt or concrete applied, the height of the cover is adjusted by placing height- adjusting rings between the top of the ring and the cover. There are other manholes that are larger and others that are smaller than the standard sanitary sewer manhole. For example, manholes for communication lines or equipment are often 3 feet in diameter at the top. These other manholes also require the setting of the cover to grade when renovating a manhole, reconstructing a manhole or installing a new manhole.

Some manholes in areas of the United States and outside of the United States have an understructure made of brick instead of a preformed barrel section or pipe. Generally, these understructures of brick or pipe have a side with steps in the structure or a ladder attached to the side for ease of access. Additionally, the step or ladder side of the understructure cooperates with a side of the eccentric cone to provide the ladder or steps to the top of the cone. The cone may also be constructed with brick. Thus, the dimensions of the cone and understructure of a barrel section may vary from those set forth above for a particular municipality's standard sanitary sewer manhole. The dimensions will be different for other sewer manholes, for other utility manholes and for those constructed of various materials, such as brick.

Access cover are often located in roadways and over time the position of surrounding material deteriorates so that bumps are encountered by the vehicles using the roadway. Sometimes the bumps are caused by holes or cracks in the material surrounding the cover. Other times the bumps are caused by the surface of the cover not being aligned with the surface of the roadway or not level with the roadway. The cover may be tilted relative to the roadway or sit below the surface of the roadway because of deterioration in the housing supporting the ring and cover or in the material used during installation to bring the cover up to the desired height aligned with the roadway. Also, resurfacing the street may leave the cover below the surface of the new roadway. In these cases, the manhole will either be renovated or reconstructed. The term renovation will be used to cover both reconstruction and renovation.

The renovation of manholes is a time consuming and labor intensive job. Each time a manhole is to be renovated, traffic control has to be put in place before work can begin. Thereafter, the material around the cover and ring has to be removed. One or more men, operating jackhammers and shovels, break through the roadway surface and the underlying material, down to the flange on the ring. The breaking up of asphalt roadway with jackhammers leaves a raised lip, commonly known as the "volcano effect". Typically, the removal of material stops at the flange area of the ring The height can then be adjusted or not. Also, often times when the height of the cover needs adjusted, the removal continues down to the top of the cone and a few inches below.

The roadway surface is typically asphalt or concrete. The material under the roadway around the ring and upper part of the cone, is either asphalt, concrete or road base. Once the roadway material and underlying material is broken down and removed and the cover set to grade, if not already at grade, the hole is filled with new material.

An adjustment of the height of the cover is done by using material between the top of the cone and the bottom of the ring. Preformed material, such as adjusting rings, do not provide incremental adjustment, only a gross adjustment. Fine adjustment of the height of the cover is needed. The time to set up and do the work to renovate a manhole, without height adjustment, often averages between one to two hours or more. When height adjustment is required it takes an extraone-half to one hour. When there are a series of manholes, in a roadway that need adjusted and using the typical operation described above, between 4 and 5 covers are typically adjusted in a normal workday. Time limitations are commonly in effect by local jurisdictions so that traffic may be detoured only during certain hours. This drastically reduces the time available to perform the necessary work.

The first installation of a ring and cover for a newly installed manhole or other utility access requires removal of a portion of the underlying material down to the top of the cone or the top of the riser sleeve for utility accesses that are not designed for personnel going underground.

Again, jackhammers are used to break up the material and shovels are used to remove the material. An improvement in this process is the cutting a plug out of the roadway by a rotary cutter, such as that made by Stehr Baumaschinen GmbH. The cutter cuts out a plug that may be removed mechanically by a scoop on a skidster or backhoe, for example. Once the plug (circular piece of roadway) is removed, the underlying material is loosened and

shoveled out down to the top of the cone.

The top of the cone is covered with a steel plate to keep material out of the manhole. Similarly, the top of the riser for smaller access holes is covered with a plate. The plate is removed and the ring and cover are installed by using height- adjusting material to set the cover to grade.

A problem also exists when a roadway is to be resurfaced. A layer of roadway is milled off or cut away. The milling machines are large devices that cut down large widths of roadway. These machines are too large to maneuver around utility access covers and rings. Consequently, in the past , scoops or jackhammers and shovels have been used.

Summary of the Invention

It is an overall object of this invention to reduce the time and labor to set access covers to grade. Where the adjustment is associated with renovation, in place of jackhammers and numerous men on the jackhammers and shovels, a rubblizing bit is used with a prime mover. The bit is powered hydraulically, pneumatically, or electrically from a machine operated by one person. One such machine or prime mover for driving the bit and controlling the position of the bit is a skidster.

The bit has a cylindrical central core that has an inner diameter slightly larger than the outside diameter of the ring and a wall thickness sufficient for strength and durability. A plurality of teeth are attached to the bottom surface of the core. One or more carriers of rubblizing teeth are attached to the central core and the rubblizing teeth extend beyond the circumference of the central core a selected distance to rubblize the material around the ring and down to the desired depth. Where the ring has a flange, this depth is down to the flange of the ring. Each carrier has a mounting plate at the top, which fits in a slot in the central core, or fits on top of the central core. The mounting plate is either welded or bolted to the central core or positioned between two mounting plates that are permanently attached to the core to hold the carrier in place. The carrier further includes a vertical portion or plate that determines the extension of the carrier from the mounting plate at the top to the rubblizing teeth at the bottom. An attachment plate is attached to the vertical plate at the bottom of the plate at a right angle to carry the rubblizing teeth. A pair of triangular pieces of metal, having a right angle that fits between the vertical plate and the attachment plate, is welded between the vertical plate and the attachment plate to strengthen the carrier of the rubblizing teeth. A plurality of teeth are attached to the bottom side of the attachment plate at selected

distances from the vertical plate and the outside diameter of the central core. There is a first row remote from the vertical plate consisting of a pair of teeth and then inside the outside pair of teeth is another pair of teeth. The outside pair of teeth are slanted to the outside of the attachment plate to meet and cut the material before the outside edge of the attachment plate engages the material. Inside these pairs of teeth are 3 teeth that are staggered at shorter distances from the vertical plate or central core of the bit. Additionally the pairs of teeth are stepped down and are at the greatest depth relative to bottom surface of the central core of the bit. Advantageously, there are three carriers with rubblizing teeth, spaced 120 degrees apart around the central core of the bit.

The inside diameter of the cylindrical central core is greater than the outside diameter of the ring to provide sufficient clearance for ease of rotation of the rubblizing bit to grind the material around and beyond the ring. This inside diameter for typical access covers and rings for water valves is 10 inches. This diameter nay be greater or lesser depending on the size of the ring. Further, the inside diameter for sanitary sewer rings and covers is 27 inches. Again this diameter may be greater or lesser depending upon the outside diameter of the ring.

The method of setting existing utility access covers to grade will be explained in connection with a sanitary sewer manhole for a particular municipality. The method is not limited to sanitary sewer manholes with preformed cones and barrels, but applies to manholes made of other material such as brick. The method also applies to manholes of other sizes and to smaller utility access covers.

The method of setting manhole covers to grade employs the following steps when an existing manhole is being renovated. First the traffic control devices and person is set in place. Next the rubblizing bit is used and as it rotates it grinds and rubblizes the material around the ring down to the flange. The third step is to vacuum the rubblized material, which may take place while the rubblizing bit is rotating or after the bit has rubblized down to the flange. Once the material has been rubblized, the bit is pulled out of the hole and the vacuuming is completed to completely remove the rubblized material. If the height of the cover does not need adjusted, the hole is filled with new material to complete the renovation.

Additionally, with renovation a T-lock may be desired. If so, a step is milled in the roadway surface out from the hole created by the rubblizing bit to a selected distance and depth. The step is created by teeth on a milling carrier or trimmer. There are three carriers

attached to the top of a central core and spaced 120 degrees apart to mill or grind the step. The central core may be the same core as used for the rubblizing step or it may be a central core used solely for this purpose or a central core with a larger inside diameter used to rubblize the material below the flange. When a step is milled and the hole is filled, the filling material extends out to fill this step and to form the moisture resistant T-lock.

If the height of the cover relative to the surface of the roadway needs adjusting, then a second rubblizing step takes place. In the first rubblizing step, the bit stops its downward movement when the teeth on the bottom surface of the central core reach the top surface of the steel flange on the ring. The rubblizing teeth are designed to cut through and rubblize concrete, asphalt and roadbase, but not steel. The second rubblizing step is accomplished by a bit that has a cylindrical central core with an internal diameter slightly larger than the outside diameter of the top surface of the cone in the manhole. The material below the flange and to a few inches below the top of the cone is loosened and sucked out by a vacuum. Once the rubblized material is removed, the ring and cover are lifted out of the excavation. Next all or part of the old leveling material, if any, is removed from the top of the manhole cone. A height-adjusting device is then employed. Preferably, this device does not have a set height but is adjustable and acts as a form for either concrete or asphalt around the device while holding the ring at the desired height.

If the distance between the bottom of the ring and the top of the cone is 2 inches or greater, then a form called a Whirlygig is used to adjust the proper height of the ring and cover. The Whirlygig is a form and apparatus for selecting and cutting the desired height of the form. This apparatus and system are disclosed in U.S. Patent 5934820 granted Vernon W. Hinkle on August 10, 1999 and U.S. Patent 6161985 granted Hinkle et al on December 19, 2000. The disclosures of these two patents are incorporated herein by this reference as though set forth in full. The Whirlygig forms are available from Whirlygig Company, 2418 Bishop Circle, Caldwell, Idaho 83605 (www.whirlygigcompany.com).

The form is placed on the cone and an apparatus with arms that extend to the roadway engages and references the roadway in three or more places. This establishes the final top surface of the form and the height and slope of the cover and the top of the ring. A cutting tool then cuts the top portion of the form so that it can be removed. Next the top portion and the cutter are removed. Then the ring and cover are placed on the top of the

form. The excavation up to the top of the form is first filled with concrete. Then the remainder of the excavated hole is filled with either asphalt or concrete.

If the distance between the bottom of the ring and the top of the cone is less than 2 inches, advantageously an inflatable donut shaped form with Adjusting Ring and Leveller with three or more arms are employed. An inflatable donut shaped form and Adjusting Ring are made by Stehr Baumaschinen GmbH and are available from Mountain Valley Equipment, 647 25 Road, Grand Junction, CO 81505. First the ring is attached to the holder of the Adjusting Ring. Then the ring and Adjusting Ring are placed over the excavated hole with the ring hanging above the top of the cone. The ring is centered over the cone and the top of the ring is adjusted relative to the roadway by leveling the arms of the Adjusting Ring so that the top of the ring and the cover will be on grade with the roadway. The inflatable donut is then placed inside the ring and extends down inside the top of the cone. The donut is inflated inside the ring and cone and provides a surface between the bottom of the ring and the top of the cone as a form for concrete to establish the height and to hold the ring at the established height above the cone. The inflated donut forms a seal at the bottom of the ring and at the top of the cone to prevent the filler material, typically a concrete material, from seeping into the manhole cone. A T-lock in the roadway around the manhole may also be used when the cover and ring height is adjusted. The milling or trimmer bit is used with the first or the second rubblizing bit in the first or second rubblizing step or as a separate trimmer bit mounted on its own central core.

The above apparatus and steps of the method are applicable to the setting of manhole covers to grade for the initial installation of a ring and cover on earlier installed understructure (barrel section or pipe and base) and eccentric cone. In this application, a coring bit is located above the cone and cuts out a circular section of the roadway. This circular section or plug is lifted out and discarded. In new construction of a manhole, the cone is covered with a plate before the hole over the cone is filled and the road surface laid down. Thus, the excavation goes down to the plate so that it may be removed. The underlying material down to the top of the cone is sucked out by vacuum. If loosening of the material is required, a lightweight jackhammer supplied with pressurized air from the vacuum truck is used.

After the plate is removed, the distance between the top of the cone and the surface of the roadway is determined. This distance dictates the type and height of ring to be used

and the height-adjusting device to be used. The height adjusting device is advantageously, either a Whirlygig form or an inflatable donut. Other height adjusting devices may be used.

If a T-lock is to be included, a trimmer bit is used to cut a step in the roadway at the same time as cutting the plug or at a different time.

A rubblizing bit or trimmer bit is also useful when resurfacing a roadway. The time consuming process of breaking up the material with a jackhammer and removal with a shovel or scooping out a desired depth with a mechanical device is very inefficient. A trimmer bit having a reach greater than the bit for milling a T-lock is used. The bit has a central core that fits around the ring and grinds down into the material around the ring to stabilize and position the trimmer bit. The bit grinds or mills the roadway down a desired depth, which is typically 11/2 inches or 2 inches for resurfacing.

Objects, features and advantages of this invention will become apparent from a consideration of the foregoing and the following description, the appended claims and the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a cross-sectional elevation view of a manhole with a properly positioned cover using asphalt;

Fig. 2 is a cross-sectional elevation view of a manhole with a properly positioned cover using concrete;

Fig. 3 is a top plan view of a properly positioned cover with section lines 2-2 for the cross sectional views of Fig. 1 and Fig. 2;

Fig. 4 is a cross-sectional elevation view of the top portion of a manhole with the cover being misaligned with the roadway, in accordance with the present invention;

Fig. 5 is a top plan view of deteriorated road surface around a manhole cover, in accordance with the present invention;

Fig. 6 is a perspective view of the rubblizing bit attached to a machine for controlling the position and operation of the bit, in accordance with the present invention;

Fig. 7 is an enlarged view of the rubblizing bit with part of the supporting structure removed, in accordance with the present invention;

Fig. 8 is a bottom plan view of the rubblizing bit, in accordance with the present invention;

Fig. 9 is a top plan view, partially cut away, of the rubblizing bit with the carrier placed in slots in a central core and held in place by plates welded to the central core, in accordance with the present invention;

Fig. 10 is a cross-sectional view of the right rear quarter of a rubblizing bit, in accordance with the present invention;

Fig. 11 is a bottom plan view of a carrier for rubblizing teeth, in accordance with the present invention;

Fig. 12 is a right side elevation view of the carrier with rubblizing teeth, in accordance with the present invention;

Fig. 13 is a perspective view from the right front of the carrier with rubblizing teeth, in accordance with the present invention;

Fig. 14 is a cross-sectional view showing the rubblizing bit in use in the renovation of a manhole, in accordance with the present invention;

Fig. 15 is a top plan view of an alternative attachment of the carrier of the rubblizing teeth to the central core of the rubblizing bit, in accordance with the present invention;

Fig. 16 is a front elevation view of the right half of the rubblizing bit with the carrier welded to the top of the central core of the bit, in accordance with the present invention;

Fig. 17 is a top plan view of an alternate attachment of the rubblizing teeth carrier to the central core of the rubblizing bit, in accordance with the present invention;

Fig. 18 is a elevation view of the right half of the rubblizing bit of Fig. 17 with the carrier attached to the central core, in accordance with the present invention;

Fig. 19 is a left side elevation view in schematic of a vacuum truck, in accordance with the present invention;

Fig. 20 is a top plan view in schematic of the vacuum truck, in accordance with the present invention;

Fig. 21 is a perspective view of the prior art form and apparatus as used in accordance with this invention;

Fig. 22 is a cross-sectional elevation view of the form and apparatus of Fig. 21 in use, in accordance with the present invention;

Fig. 23 is a cross-sectional elevation view of the ring and cover at its proper elevation with respect to the roadway with a cut T-lock step, in accordance with the present invention;

Fig. 24 is a cross-sectional elevation view of the renovated manhole with the cover at its proper elevation with a T-lock connection to the roadway, in accordance with the present invention;

Fig. 25 is a cross-sectional elevation view of an inflatable donut shaped form of the Stehr design in use, in accordance with the present invention;

Fig. 26 is a cross-sectional elevation view with the manhole cover at the proper level using the form of the Stehr design, in accordance with the present invention;

Fig. 27 is a front elevation view of a T-lock miller or trimmer, in accordance with the present invention;

Fig. 28 is a front elevation view, partially cut away, of the right side of a T-lock milling bit with an alternative attachment of the carrier of the T-lock teeth to the central core of the bit, in accordance with the present invention;

Fig. 29 is a top plan view of an elevated manhole cover at grade with a T-lock in the roadway, in accordance with the present invention;

Fig. 30 is a top plan view of an adjusting ring device for use with an inflatable donut shaped form, in accordance with the present invention;

Fig. 31 is a cross-sectional elevation view of the understructure of a new installation, in accordance with the present invention;

Fig. 32 is a perspective view of a core bit and rubblizing bit, in accordance with the present invention;

Fig. 33 is a front elevation view of the bit of Fig 32, in accordance with the present invention;

Fig. 34 is a bottom plan view of the bit of Fig. 32, in accordance with the present invention;

Fig. 35 is a perspective view of the bit attached to a prime mover, in accordance with the present invention;

Fig. 36 is a cross-sectional view of a covered manhole cone with an excavated hole down around the plate on the cone, in accordance with the present invention;

Fig. 37 is a cross-sectional view of the manhole cone with cover plate removed and ready for installation of ring and cover, in accordance with the present invention; and

Fig. 38 is a cross-sectional elevation view of the right rear quarter of a trimmer bit for a T-lock or for milling in resurfacing a roadway, in accordance with the present invention.

Description of Preferred Embodiments

Utilityaccess covers in roadways are hardly noticeable if properly aligned with the roadway. Proper alignment of the standard manhole cover for sewer manholes, as required by a municipality, is shown in Figs. 1-3. This invention will be illustrated in connection with such a standard sanitary sewer manhole. However, the grinding bits and methods are also applicable to other manholes and to smaller utility accesses that do not require personnel access underground Also this invention is especially useful where the underlying structure is composed of brick or other similar material and not preformed.

In the standard sanitary sewer, a sewer pipe 1 is located at the bottom of a manhole, as shown in Figs. 1 and 2, and is positioned on a base 3. The access hole for access to the sewer pipe 1 is provided by a manhole barrel section or pipe 2, sitting above the base 3 and extending upward toward the roadway 4. An eccentric cone 5 is placed on top of the manhole barrel section 2 and extends up toward the road surface. At least one municipality limits this distance to 20 inches. The distance between the top surface 12 of the cone and the surface of the roadway 4 typically has a standard of no greater than 24 inches. A cover 6 is supported above the cone 5 by a ring 7 and height adjusting elements 8.

In the standard sanitary sewer manhole, the manhole barrel section 2 has an inside diameter of 4 feet and the eccentric cone 5 transitions from an inside diameter of 4 feet at the top of the barrel section 2 to an inside diameter of 2 feet at the top of the cone. Further, the barrel section 2 and bottom of the cone 5 have a wall thickness of 5 inches. The wall thickness of the cone 5 increases to 6 inches at the top of the cone. The ring 2 comes in standard heights of 4 inches, 6 inches, 8 inches, and 12 inches. The jurisdiction governing the manhole specification establishes the standard dimensions for that jurisdiction. Grand Junction, Colorado, for example, requires a 6-inch high ring, while Denver, Colorado typically requires an 8-inch high ring.. The cover 6 has a 24 inch or 2 foot diameter and the

ring 7 has an outside diameter of 25 ½ inches. Ring 7 has a flange 9 near the bottom of the ring that acts as a weight supporting and locking device. When either asphalt or concrete is poured around the ring and height adjusting elements 8 it flows under and over the flange 9 to lock the ring in place. The flange 9 has a space above the height adjusting elements 8 as the result of a mug ring 17 under the flange and extending to the bottom of ring 7. Not all rings have such mud rings. The ring adjusting elements and the top of the cone 5 are encased in asphalt 10 as shown in Fig. 1 or are encased in concrete 11 as shown in Fig. 2.

Over time the alignment of the cover 6 relative to the surface of the roadway 4 changes or may change because of deterioration in the supporting surfaces, improperly compacted underlying material or resurfacing of the roadway which adds additional asphalt or concrete above the height of the cover 6. The possibility of change may be noted during routine inspections of a manhole. Sometimes, wood shims have been used to adjust the height of the ring and cover relative to the surface of the roadway. This wood can and does rot out, causing a shift in the alignment of the ring and cover. Also, metal washers or other metal shims can rust out and cause shifting in the alignment of the ring and cover. Another reason for misalignment of a ring and cover of a manhole is settlement around the ring and cover due to lack of proper compaction at the time of installation. Further, the roadway surface around the cover 6 often times deteriorates because of aging and weather. If cracks form in the material around the cover, moisture can penetrate down into the cracks. Chunks of material can be dislodged, especially where freezing takes place, resulting in holes around the cover 6. The cover 6, being below the surface of the roadway 4 is shown in Fig. 4. The cover below the surface in Fig. 4 is illustrative only of misalignment. The distance down can be as much as 4 inches or more when the roadway is resurfaced. Also, the cover can tilt relative to the surface of the roadway. Cracks 14 and chips 15 around the cover 6 are shown in Fig. 5. These conditions require renovation of the manhole.

Renovation requires removal of the material around the cover 6 and ring 7 at least down to the flange 9 of the ring 7. This material is easily removed by using the rubblizing bit of this invention and sucking out the rubble with a vacuum. The rubblizing bit provides easy breaking up of the material into small pieces about the size of one and one-half inch gravel so that the material may be easily sucked out by a vacuum.

As an example of the efficacy of the rubblizing bit and the method of this invention, there were 47 manholes requiring renovation in about 3 miles of roadway. Bids to do the

renovation employing the old system of jackhammers and shovels, covered a range of approximately $40,000 - $90,000. The bid using the rubblizing bit of this invention and the method of this invention was about $23,000. The apparatus and method of this invention is much faster in setting manhole covers to grade and three to four times as many or more can be set in a normal workday with less labor.

The detail and use of the rubblizing bit for the illustrative sanitary sewer manhole is illustrated Figs. 6-18. In Fig. 6, the rubblizing bit 20 is shown in housing 21 attached to a skidster 22, partially shown in Fig. 6. The rubblizing bit 20 and housing 21 may be attached to other motorized vehicles or prime movers that provide means for controlling the position of the rubblizing bit and the operation of the bit. As noted above, the prime mover may be any device that provides power to move the bit and rotate the bit. The housing 21 is attached to the skidster 22 by a coupler 23 and by hydraulic hoses 24. The hydraulic hoses 24 provide means for controlling the up and down operation of the rubblizing bit 20 and for rotating the bit when desired. Housing 21 has legs 25, which stabilize the position of the rubblizing bit 20. A safety screen can be connected between the legs 25 around the housing 21 to prevent chunks of material from flying beyond the housing 21.

The rubblizing bit 20 has a cylindrical central core 30 that is open at the bottom and closed at the top 36 as show in Figs. 7-10. The central core 30 has a wall 31 and a surface 35 at the bottom of the wall 31. Teeth 32, Fig. 8 (These teeth are also numbered 38 in Figs.10 and 14) are attached to the bottom surface 35 between the inner diameter 33 of the wall 31 and the outer diameter 34 of the wall 31. The wall 31 is ½ inches thick and the central core 30 is made of steel to provide rigidity and durability.

The rubblizing bit 20 further includes a plurality of carriers 40 that are attached to the central core 30. As seen in Figs. 12 and 13 the carrier 40 has an upper mounting plate 41 that is attached to the central core 30 by one of various means. As shown in Fig. 8, the mounting plate 41 is welded to the inside surface of the top of the central core 30. The plate 41 is welded, as shown by the bead lines 43, to the top 36 (Fig. 8). The carrier 40 has an attachment plate 44 at the bottom, which carries the rubblizing teeth for the bit. The attachment plate 44 is spaced a distance from the mounting plate 41, determined by a vertical plate 45 that connects between the mounting plate 41 and attachment plate 44. The carrier 40 is strengthened by two triangular plates positioned between the attachment plate 44 and

vertical plate 45. The strengthening plates 46 and 47 have right angles with the edges 48 attached to the front surface of vertical plate 45 and edges 49 attached to the top surface of attachment plate 44.

The attachment plate 44 has an outer curved surface 50 that matches the outer curved surface of the central core 30 and has a radius that extends from the central axis of the central core 30. This radius may be any desired length determined by the size of hole around the ring to be excavated by the bit and vacuum. A leading edge 51 and trailing edge 52 of the attachment plate are not at right angles to the vertical plate 45, but rather are at obtuse angles to the vertical plate 45. There are several rows of rubblizing teeth attached to the bottom of the attachment plate 44. The first row of rubblizing teeth 54 are a pair of teeth on a radius that is one-half inch shorter than the radius for the outer curved surface 50, which is 191/2 inches from the center of core 30.. A second row of a pair of rubblizing teeth 55 are attached to the bottom surface of the attachment plate on a radius that is two inches shorter than the radius of the outer curved surface 50. Three additional teeth 56, 57 and 58 are attached to the bottom of the attachment plate at radii that are increasingly shorter than the radius of the pair of teeth 55. The teeth 56, 57 and 58 are at one depth and extend a first distance below the attachment plate 44. The teeth 55 are at a second depth and extend further from the bottom of the attachment plate 44 than the teeth 56, 57, and 58. The outside row 54 of rubblizing teeth extend the deepest relative to the bottom of the attachment plate 44. The teeth 55 can be attached to a first step in the attachment plate 44 or to a separate lowering plate 59 as shown in Fig. 12. To get the pair of teeth 54 at a depth greater than the pair of teeth 55, the teeth 54 are attached to the lowering plate 59 with an additional lowering bushing 60. The rubblizing teeth attached to the bottom of attachment plate 44 are tilted toward the leading edge 51 to contact and rubblize the material as the grinding bit is rotated into the ground. Further, the outside pair of teeth 54 are angled out beyond the outer curved surface 50 to contact the material to be rubblized and removed before surface 50 contacts the material.

When the carrier is mounted on the central core 30, the bottom of attachment plate 44 is above the bottom of the teeth 38 that are attached to the bottom surface 35 of the central core 30. The teeth 56, 57, and 58 attach to the bottom of attachment plate 44 and have tips that are ¼ inch above the tip of the teeth 38 on the bottom surface 35 of the central core 30. The depth of the rubblizing teeth is best seen in Figs. 10 and 12. In Fig. 10, the teeth 38 on the bottom surface 37 of central core 30 extends below the teeth 56,57 and 58 attached to the

attachment plate 44 of carrier 40. The tips of the pair of teeth 55 extend ¼ inch below the tips of the teeth 38 and the tips of the pair of teeth 54 extend 1 inch below the tips of the teeth 38. All of the teeth have a hardened steel body and a carbide tip.

The rubblizing teeth carrier of Figs. 6-10 fit in a a slot in the side of the central core 30 of the grinding or rubblizing bit 20. Inside the slot, the mounting plate 41 is either welded to the inside top surface of the central core 30 (Fig. 8), or held in place between plates 27 and 28 that are welded in place by weld beads 29 and 26 (Fig. 9).

The mounting plate 41 is three-fourths inches thick, attachment plate 44 is five-eighths inches thick and vertical plate 45 is three-eighths inches thick. All are made of steel plate. The mounting plate 41 is tapered to easily slide into the metal plates 26 and 29 that are welded to the top of the core 30 or into slots in the side of the core to be held by plates or welded. At the point of attachment to the vertical plate 45, the mounting plate 41 has a width of 9 ½ inches and at the end remote from the vertical plate 45, the mounting plate 41 has a width of 5 ¾ inches. The attachment plate 44 extends 6 inches outside the vertical plate 45, which has a height of 9 inches and a width of 9 ¼ inches. The braces or strengthening triangles 46 and 47 are made of three-eighths inch steel plate and are spaced 7 inches apart against the vertical plate 45.

In an alternative embodiment, shown in Fig. 15, the mounting plate 41 of the carrier 40 is welded to the top surface 36 of the central core 30. The mounting plate 41 welded to the top 37 of the central core 30, is also shown in Fig. 16. Alternatively, the mounting plates 41 may be bolted to the central core 30 as shown in Figs. 17 and 18.

The rubblizing bit is useful where the height of the utility access cover needs adjusting as well as where the cover does not need adjusting relative to the surface of the roadway in which it is located. The operation of the bit will first be described in connection with a sanitary sewer manhole where the height of the cover (lid) does not need adjusting. The first step is the setting out of traffic control devices and if necessary, a flag person. The second step is centering the rubblizing bit 20 over the manhole cover 6 and causing it to rotate as it goes down against and into the material around the cover 6 and ring 7. The material is either asphalt or concrete, with roadbase below. The cover has a diameter of 24 inches and sits in a ring that has an outside diameter of 25 ½ inches. The inside diameter of the rubblizing bit is 27 inches so that there is a three-fourths inch clearance between the

outside diameter of the ring 7 and the inside diameter of the bit 20. As the bit rotates and moves down around the cover 6 and ring 7, it chews up (grinds) or rubblizes the material. The result is rubble or small pieces the size of one and one-half inch gravel that are small enough to be sucked out of the hole by a vacuum. The open end of a vacuum hose 64, shown in Fig. 14, is placed in the hole 18 being ground out by the rubblizing drill bit 20. The rubble is sucked up through the hose 64 into a vacuum tank 65, located on a truck 66 (Figs. 19 and 20). The vacuum can be transported on a trailer as well as on a truck. The removal of the rubble, while the rubblizing bit 20 is drilling the hole, makes it easier for the bit to rotate and reach the desired depth. The desired depth of the bit 20 is where the teeth 38 touch or engage the flange 9 of the casting or ring 7. The teeth 38 on the bottom surface 35 of the cylindrical central core 30 cut into and through asphalt, concrete and roadbase, but not steel. Consequently, when the teeth 38 contact the steel of flange 9 the rubblizing bit cannot descend further. The desired depth of rubblizing has been reached.

With the rubble sucked out, the bit 20 has created a hole approximately 3 1/3 feet in diameter, with the outer portion of the hole being deeper than the inner portion established by the teeth 38 on the central core and teeth 56-58 on the carrier 40. Teeth 54 on the outer periphery of the carrier 40 and teeth 55 cut down below the flange 9. In this way the bit breaks loose the flange 9 from the top of cone 5 or the height adjusting material 8. The rubblizing bit is then pulled up out of the excavated hole 18. The height of the cover 6 is checked and, if it is in proper position, the hole 18 is filled with either asphalt or concrete. The traffic control and equipment can then be moved to the next utility cover to be set to grade.

There are additional steps in the method where the cover 6 and ring 7 need to have a height adjustment relative to the surface of the roadbase. Sometimes when the roadbase is resurfaced, the resurfacing is done around the manhole cover or over the manhole, leaving the cover below the surface of the roadway. Additionally, there are times when the supporting structure, such as the height adjusting rings 8 or shims (not shown) have broken down and the height of the cover 6 and ring 7 are below the street level or at least one side is below the surface of the roadway.. In all cases, the renovation includes setting the height of the ring and cover to grade or aligned with the surface of the street.

First the traffic control devices are put in place and if necessary a flag person is used so that the renovation, including the adjustments of the height of the manhole cover may be done safely. Again, the rubblizing bit 20 is centered over the manhole cover and it is caused to rotate as it goes down against and into the material around the cover 6 and the ring 7. Again, as the teeth 38 reach the flange 9 of the ring 7, the rubblizing bit stops and the vacuum completes the removal of the rubble from hole 18. The rubblizing bit 20 is removed from the hole 18. Rubblizing or in-situ grinding of the material is more desirable than jackhammering, which leaves large, heavy pieces of material that have to be manhandled or machine loaded into a disposal unit.

After removal of bit 20, another bit 79 (Fig 27), having only a central core 80, of the same construction as the central core 30, with teeth on the bottom surface of the cylindrical portion of the central core, is substituted for the rubblizing bit 20 in the housing 21 or placed in another housing, as shown in Fig. 6. The internal diameter of the central core 80 of the bit of Fig. 27 is 43 inches so that it will go down and around the top portion of the cone 5 of the illustrative standard sanitary sewer manhole, which at it's uppermost reach is 36 inches in diameter, or 3 feet across. In this way the material down around the top of the cone 5 is broken loose and sucked out by the vacuum unit 66 through hose 64. At this point the bit 79 is pulled out of the hole and the ring 7 and cover 6 are removed from the hole as well as any height adjusting rings 8 on top of the cone 5. As noted above the bit 79, shown in Fig 27, has an additional set of teeth used for creating a step for a T-lock that may not be present for this operation.

The design and use of the rubblizing bit 20 is especially advantageous where the cone and barrel section or pipe are constructed out of brick. Because the rubblizing bit 20 stops at the flange of the ring, the bit will not go into the underlying brick. However, in the past, cones made of brick have been damaged by the jackhammers used in the prior art method.

If the distance between the bottom of the ring 7 and the top surface 12 of cone 5 is greater than 2 inches, a cuttable form 30 is used to provide the proper height for the cover 6. This form, as described above, is disclosed in detail in U.S. Patent 5934820 ('820) granted on August 10, 1999 to Vernon W. Hinkle and U.S. Patent 6161985 ('985) granted December 19, 2000 to Vernon W. Hinkle and John D. Tensen. The apparatus is disclosed in the '985 patent

and the process for employing the apparatus is covered in the '820 patent. The '820 patent and '985 are incorporated herein by this reference as though set forth in full.

As shown in Figs. 21 and 22 and described in the '820 patent, the form 70 is placed in the hole 18 on top of the top surface 12 of the cone 5. The form 70 is a tubular cone that is wider at the bottom to fit on the top surface of the cone 5 and narrower at the top to fit under the ring 7.The form is comprised of a material that is strong enough to support a concrete pour. The form 70 is stabilized on the top surface 12 of the cone 5 and a trimmer jig frame 72 is placed on the surface of the roadway and internal of the form 70 as shown in Fig. 22. The jig frame 72 has a circular member 73 with horizontal tabs 74 on the outside of the circular member 73, which rest on the surface of the roadway to which the cover 6 of the manhole cover is to be adjusted. The jig 72 further has vertical tabs 75 on a X-shaped cross frame 76. The vertical tabs 75 fit inside the form 70 to stabilize the form 70 while it is cut to provide the precise height for the form 70 and, thus, the ring 7 and cover 6 relative to the surface of the roadway. The amount of tubular form 70 to be trimmed away by the inverted trimmer is determined by measuring the critical dimension of the manhole ring 7. This critical dimension is the distance from the upper surface 13 of the ring 7 and the bottom surface 16 of the flange 9 as shown in Figs. 23 and 24. A cutter 77 of the trimmer 72 is then positioned to cut the form 70 at a distance from the top down that is equal to the critical distance of the ring 7 between its top surface 13 and the bottom surface 16 of flange 9. Upon completion of the cutting of the form 70, the trimmer jig frame is removed. The ring 7 is placed on top of the trimmed form 70 as shown in Fig. 23. The area around the form is filled with concrete to the bottom of flange 9, and when sufficiently cured, the balance of the hole 18 is filled, either with concrete or asphalt.

If the hole 18 is filled with asphalt, a further feature of the invention may be employed as shown in Figs. 23 and 24. After the rubblizing bit 20 has been removed, a bit 79 shown in Fig 27, with a larger inside diameter central core 80 is attached and used to complete the loosening of the material around the bottom of the ring 7 and the top of the cone 5. This bit is modified to provide a T-lock 99 that reduces the possibility of moisture getting down into the area of the manhole. This bit also removes any elevated road material at the edge of the hole. Carriers 81 for a T-lock trimmer 86 (milling bit) is attached to the central core 80 of the larger circumference bit 79 as show in Fig. 27. Carrier 81 has a mounting plate 82 that fits in a slot 83 in the side of the central core 80. The mounting plate 82 also

extends beyond the circumference of the central core 80 by 6 inches to provide a further cut or step 90 (Fig. 23) in the road surface. When the hole 18 and step 90 are filled with asphalt as shown in Fig. 24, a T-lock 99 results. The teeth of the trimmer 86 create ridges on the horizontal surface of step 90. Tack oil is placed on the horizontal surface before laying down the asphalt to create a barrier to moisture.

Teeth 85 are attached to the bottom surface of the mounting plate 82 and cut away or grind the surface of the roadway 4 as the bit 79 goes down into the hole 18 and forms the cut or step 90 in the existing asphalt or concrete surface. There are 3 carriers 81 located 120 degrees apart around the central core 80. The front carrier 81 is not shown in Fig. 27.

The T-lock trimmer 86 may have an alternative means of attachment to the central core 80 as shown in Fig. 28. In this case the carrier 91 for the T-lock teeth has a step 92 to have the teeth 93 at the desired depth with respect to the surface of the roadway 4. Carrier 91 has an attachment plate 94 for the teeth 93 and a mounting plate 95, both of which are horizontal relative to the vertical member 96. Vertical plate 96 provides a step of selected distance between attachment plate 94 and mounting plate 95. In a 3 inch thick asphalt or concrete surface, the cut 90 will be 1 ½ inches deep to provide the T-lock. The depth and width of the T-lock may vary depending upon the material and road conditions. Additionally, the central core 80 may have a short height, such as 6 inches, and no teeth on the bottom surface. In this case, the bit will only function as a trimmer bit.

If the distance between the bottom of ring 7 and the top surface 12 of cone 5 is less than 2 inches, then an inflatable donut shaped form 100 is employed as shown in Fig. 26. A means for positioning and orienting the top of the ring 7 relative to the surface of the roadway is available form Mountain Valley Equipment and is manufactured by Stehr Baumaschinen GmbH, This device is called an Adjustable Ring and Leveling Rule 98. This device (shown in Fig 25) has three arms 104 (Fig.30) that extend out from a center piece 103 to lie on the surface of the roadway 4. Additionally, the Adjustable Ring has a means for holding the ring 7 consisting of clamps 107 in cooperation with adjustable clamp 105. The clamp 105 has a movable arm that extends down into the ring where the cover will be positioned. This arm, when moved by handle 108 forces the ring 7 against the stationary clamps 107 to hold it in place.

The ring 7 is attached to the Adjusting Ring 98 and the combination is placed over the cone 5 with the arms 104 lying on the surface of the roadway with adjustable feet 102. The altitude or position of the top of the ring 7 is adjusted by use of a level and the feet 102. Once the top of ring 7 is on grade with the roadway, an inflatable doughnut shaped form 100 is placed inside the ring 7 and inside the top of cone 5 as shown in Fig 26.

Straps 106 extend up from form 100 and one strap is placed over the handle 108 of adjustable clamp 105. The form is then inflated to fill the space between the bottom of ring 7 and the top surface 12 of cone 5 to provide a surface 110 that holds out the concrete poured around the form 100 and bottom of the ring 7. The inflated form 100 seals against the bottom inside surface of ring 7 and the top inside surface of cone 5 to prevent seepage into cone 5 of the grout or concrete that is poured into the hole up to the top of flange 9. When the concrete is cured, the doughnut shaped form 100 is deflated and removed. The remainder of the hole is then filled with concrete or asphalt and the cover 6 is put into place.

Another occasion where the cover and ring of a manhole are involved is where they are at grade with the present surface of the roadway and the roadway is to be resurfaced. Generally, old road material is milled down so that a new layer of material may be laid down to result in the same surface level. In the past, it has taken considerable time to mill around each ring and cover of the manholes in the street. This has been done with milling brushes on prime movers, such as skidsters, by scoops on skidsters or backhoes, or with jackhammers and shovels. A more efficient and faster way is to employ a trimmer 112 shown in Fig. 38,with a central core. The central core may have teeth at the bottom, as shown in Fig. 38, or may be just a carrier for the trimming or milling teeth 115. There are a plurality of carriers 114 with trimming or milling teeth 115 attached to an attachment plate 116. The attachment plate and teeth extend out 12 inches from the outside surface of the central core. This distance may be more or less depending upon how close the large milling equipment is able to get to the access hole. The milling around each manhole may be done before or after the milling of the street.

The central core has an inside diameter of 27 inches for the standard sanitary sewer manhole cover and ring. The carrier 114 (Fig.38) has an attachment plate 116 that extends 12 inches beyond the outside diameter of the central core 113. A plurality of teeth 115 are attached to the bottom of the attachment plate 116. The trimmer 112 is attached to a prime mover, such as a skidster, for positioning and rotation. The height of the central core 113 is 6

inches from the top 117 of the core 113 to the tip of the teeth 118 at the bottom of the central core 113. This height only has to be sufficient to cut down 11/2 inches for the typical roadway.

The carrier 114 has a mounting plate 119 that is slid into a slot in the side of the central core 113 and is held in place by plates (not shown) and welded to the inside of the top 117. The plate 119 may also be welded to the top 117 of the core 113 or bolted in the sot or on top.

The bit without attachments is useful in setting the ring and cover in new installations. These new installations may be of small access covers or large access covers, such as used for manholes.

In a new installation, as illustratively shown for a manhole in Fig. 31, other cone and other understructure is in place when the roadway is put down. The cone 5 is covered with a plate 120 and is covered with compacted roadbase material 121. The roadway 122 is then laid over the cone 5 and plate 120.

The cone 5, shown in Fig. 31 is a cross-sectional view that is rotated 90 degrees from the cross-sectional views of Figs. 1, 2, 4, 14, 22-26. The cone is eccentric and has a surface 123 that is relatively flat for attachment of an access ladder.

The location of the covered cone under the roadway is generally marked by two or more marks on the curb or the side of the roadway. Intersecting arcs are used to locate the center of the cone.

Once the center of the cone is determined, a core bit 124, as shown in Figs. 32 and 35, is centered over the cone. This core bit 124 has exterior flanges 125 that curve from the bottom of the bit to its top to assist in bringing up the ground up roadway and roadbase. Stehr Baumaschinen GmbH has made a core bit without these flanges 125. Stehr now makes a core bit with flanges that are available from Mountain Valley Equipment. The core bit is also shown in Figs. 33 and 34 without the flanges 125.

The core bit is used to cut a circular plug (not shown), out of the roadway. This plug is moved out of the circular hole cut by bit 124. The plug may be moved by a scoop on a skidster or by some other means. After removal of the plug, the underlying material is sucked out by vacuum.

If the material is too tightly compacted, a small jackhammer is supplied by pressurized air from a compressor (not shown) mounted on the vacuum truck 66 (Figs. 19

and 20) and is used to loosen the material. In any event, the material is sucked out by vacuum to significantly speed up the process of setting the new ring and cover. Once the hole 126 is evacuated down to the top of the cone 5, the plate 120 is removed.

The distance 127 from the top of the cone 5 to the surface of the roadway 122 is determined. Based upon the distance, an adjustable height form, such as the Whirlygig or the inflatable donut is selected for use in setting the ring and cover to grade.

The bit of Figs 32 and 35 does not have a carrier for rubblizing teeth or a carrier for milling a step for a T-lock or a carrier for milling or trimming around a utility access cover.

The core bit of Figs 32 and 35, depending upon its dimensions and attachments, has many uses. One use is rubblizing down to the cone area of a manhole after a rubblizing bit has rubblized down to and around the flange of the ring. Another use is the rubblizing with carriers of rubblizing teeth attached to and carried by the central core. A further use is for milling a step in the roadway for a T-lock when milling or trimming teeth carriers are attached. For this purpose the central core may have a very short height and no teeth on the bottom surface 35 or it may have a height of 12 inches or more or less with the milling teeth near the top and teeth 38 on the bottom surface 35. Also, where the trimming teeth are for milling or trimming the surface around a utility access cover during resurfacing, the inside diameter of the cone is slightly greater than the outside diameter of the ring. The teeth 38 at the bottom of the core 30 grind down around the ring and stabilizes and positions the trimmer. The teeth on the trimmer carrier extend out 12 inches or another selected distance to mill around the ring for resurfacing of the roadway area around the access hole.

Although the description above contains specificity, this should not be construed as limiting the scope of the invention, but merely as providing illustrations of one of the presently preferred embodiments of the invention. Although preferred embodiments and method for renovating manholes have been described above, the invention is not limited to the specific embodiments, but rather the scope of the invention is to be determined as claimed.